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# THE MUSHROOM INDUSTRY OF PENNSYLVANIA

By C. R. Mason

Pennsylvania Grown Mushrooms Being Graded For Market

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# PENNSYLVANIA DEPARTMENT OF AGRICULTURE

## Organization and Services.

FRANK P. WILLITS, *Secretary* JOHN M. McKEE, *Deputy Secretary*

This Department is essentially a service agency created by legislative enactment to deal with administrative, regulatory, investigational, and educational problems which can best be solved through public rather than individual action. The organization provides for coordination and cooperation with the Pennsylvania State College and the U. S. Department of Agriculture. The Department operates through the following bureaus:

ANIMAL INDUSTRY: T. E. MUNCE, *Director and State Veterinarian.*

Prevents and eradicates transmissible diseases of animals and poultry, including tuberculosis of animals in cooperation with Federal Government.

Demonstrates to veterinarians control methods for transmissible animal diseases;

Supervises vaccination for and the prevention of hog cholera, anthrax, black leg and hemorrhagic septicemia;

Protects public from unwholesome meats through ante and post mortem examinations of animals at slaughtering establishments;

Inspects, licenses and furnishes information as to breeding, soundness and conformation of stallions and jacks standing for public service;

Enforces law requiring licensing of dogs and providing for protection of livestock and people from attacks of uncontrolled dogs;

Maintains laboratory for diagnostic research and experimental projects.

PLANT INDUSTRY: C. H. HADLEY, *Director.*

Tests agricultural seeds for purity and germination, and enforces State Seed Law;

Inspects orchards, parks, farms, and plant imports for injurious insects and plant diseases;

Enforces laws governing agricultural practices, disease control and housing;

Places and enforces quarantines and carries on eradication campaigns against insect pests and plant diseases;

Inspects and certifies potatoes for seed purposes;

Makes field tests of insecticides, fungicides and weed killers;

Inspects and licenses Pennsylvania nurseries, and licenses all dealers in nursery stock; makes investigations for the control of injurious insects and plant diseases;

Maintains collections of insects, plant diseases, plants, and seeds, and identifies specimens.

FOODS AND CHEMISTRY: JAMES FOUST, *Director.*

Accomplishes its purpose of protecting Pennsylvania homes against harmful foodstuffs by sampling, analyzing, and bringing prosecution under the laws relating to foods and non-alcoholic drinks, including milk, cream, butter, ice-cream, eggs, sausage, fresh meats, soft drinks, fruit syrups, vinegar and kindred food products;

Regulates and issues licenses for the manufacture and sale of oleomargarine;

Licenses and regulates egg-opening plants and cold storage warehouses, maintaining regular inspection and enforcing twelve-month storage limit;

Inspects milk plants and creameries and regulates weighing, testing, buying and selling of milk and cream on a butterfat basis;

Protects honest manufacturers, importers, selling agents and ultimate users of feeding stuffs, fertilizers, lime products, linseed oil, paint, putty, turpentine, insecticides and fungicides, by means of annual registrations followed by inspections, analyses, prosecutions and the publication of the analyses of these products;

Analyses special samples for residents of the State at the rate of $1.00 a sample for feeding stuffs, lime products and linseed oils.

MARKETS: P. R. TAYLOR, *Director.*

Investigates and assists in the marketing of farm products; at present chiefly grain and hay, fruits and vegetables, poultry and eggs, and tobacco;

Compiles and distributes daily market information as to supplies, shipments and prices;

Advises growers on transportation of agricultural products;

Assists cooperative associations and public markets;

Establishes standard grades of farm products and maintains inspection;

STATISTICS: L. H. WIBLE, *Director,*

Assembles and disseminates essential statistics and facts pertaining to the agriculture of the State, from monthly reports rendered by hundreds of volunteer crop correspondents, information which assists the producer in his sales and interests all industries which deal with agricultural products;

Cooperates with U. S. Bureau of Agricultural Economics in joint crop and livestock reporting and publishes annual and monthly summaries of the data;

Compiles dates of county and local fairs and assembles data pertaining to their success and results during each year.

# THE MUSHROOM INDUSTRY OF PENNSYLVANIA

A Cooperative Study by the

PENNSYLVANIA STATE COLLEGE

AND THE

PENNSYLVANIA DEPARTMENT OF AGRICULTURE

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This bulletin is the first of a series of three on the vegetable industry of Pennsylvania. The field work in this study was started in 1921 with Mr. C. R. Mason gathering the material. The results were made possible through the cooperation of mushroom growers and members of the staffs of the Pennsylvania State College and the Pennsylvania Department of Agriculture. Special acknowledgment is due the commercial mushroom growers who accorded liberal assistance in the course of the study.

## SUMMARY

Pennsylvania produces 85 per cent of the mushrooms grown in the United States.

The food value of mushrooms lies not so much in their actual energy value but in the variety their distinctive flavor lends to the menu.

Proper control of moisture and temperature conditions are essential to successful mushroom culture.

Mushrooms in Pennsylvania are grown in caves, mushroom houses, under greenhouse benches and in barns and warehouses. Mushroom houses, described in detail in the bulletin, are commonly used in the state.

Essential equipment for mushroom growing includes a carrier for compost, wooden hand tampers for compost, thermometers, hygrometers, weeders, manure forks, gasoline lights or electric lanterns, hose and greenhouse nozzles for watering, picking baskets for harvesting, knives, camels hair brushes, galvanized pans for burning sulphur, hand sprayers and certain other small tools.

Hot water heat usually gives more satisfactory results than steam heat in the mushroom house.

Fresh horse manure is used almost exclusively at present for mushroom growing. The manure is secured in carload lots from New York, Philadelphia and Pittsburgh. It is usually best when composted for two weeks or more before packing in mushroom beds.

Little heavy watering is needed for mushrooms if the manure has been properly prepared before placing it in the beds. Light sprinklings of water are usually best.

Thorough ventilation is essential for success in mushroom production.

The most favorable temperature for mushrooms ranges from 50 to 65 degrees Fahr.

By the use of cooling systems, some growers have extended the growing season for mushrooms more than two months or as much as four months.

Mushrooms are usually separated into three grades for each color grown. First grade includes large mushrooms not fully expanded and free from blemishes. Grade two contains a smaller size mushroom similar in maturity and condition to the first grade. Grade

three may include the "button" size or other sizes that have opened or have small spots or blemishes that do not make the product unmarketable.

Pennsylvania grown mushrooms are marketed in all the large cities of the Northern States as far west as Minnesota. Shipments to the southern states are increasing.

A yield of one-half to two pounds per square foot of bed space is considered profitable.

The most troublesome insects reported by Pennsylvania mushroom growers are gnats, springtails, mites and sowbugs. Control measures are described for all four insects. Fumigation and other control measures for common mushroom diseases are also discussed in detail.

Mushrooms are not a get-rich-quick crop. Fair profits are secured by careful growers but enormous profits must not be expected.

# THE MUSHROOM INDUSTRY OF PENNSYLVANIA

By

C. R. Mason.

## PENNSYLVANIA LEADS IN MUSHROOM PRODUCTION

Pennsylvania has been credited with producing 85 per cent of the mushrooms grown in the United States, and the remaining 15 per cent is scattered among several other states, including Ohio, Minnesota, New York, Illinois, Michigan and Missouri. With the boom that has taken place in the industry in this state during the past year or so, it seems likely that Pennsylvania will maintain her position of leadership in mushroom growing, and may even raise her percentage of the total crop grown in this country.

An idea of the recent growth of the mushroom industry may be had from the fact that during the summer of 1921 at least fifty new "banks" of various sizes were under construction in Chester county while many growers were adding improvements to their present ranges. Construction and improvement have continued with a steady growth. The years 1923 and 1924 were particularly active, many new growers starting and old growers enlarging.

Mushroom growing in Pennsylvania is centered chiefly in the lower half of Chester county and at West Winfield, Butler county. There are a few growers in Bucks, Montgomery, Delaware, Lawrence, and Lancaster counties, while a small supply from Allegheny county is placed on the Pittsburgh curb market. The industry has probably not developed according to climatic conditions but rather in localities having good railroad facilities, in the case of Butler county due to suitable caves, and in Chester county the business has grown around a few of the older growers, others in the locality being encouraged to start mushroom growing in a small way by the apparent success of these men.

Except for the largest growers, most of the men who raise mushrooms commercially do so as an adjunct to other lines of agriculture such as general farming, dairying, and the growing of flowers or vegetables under glass. Many of the smaller "banks" are now in the hands of Italians, who seem to be very successful mushroom raisers.

The only mushroom cannery in successful operation in the country at present is run by E. H. Jacobs and Company. The packing house and the cannery are combined, so that from the bed run of mushrooms, certain grades are selected for canning, while the remainder are packed and marketed as usual. The capacity of the cannery is about 80,000 cases a year. Three grades are packed, medium sized mushrooms for the best grade, small size with stems removed for Chinese trade (for use in chop suey and similar dishes), and the removed stems for soup stock. Canned mushrooms are shipped by this firm to all parts of the United States and Canada.

## PURE CULTURE SPAWN AIDS GROWERS

The use of pure culture spawn has exerted a great influence on the mushroom business. Before its introduction a few years ago the chances for continuous profitable crops were small; now with reliable spawn the careful grower has reasonable assurance of success.

The making of spawn is a business in itself, involving as it does a knowledge of bacteriological technique, skill, and special equipment, as well as requiring continual experimentation for progress and improved strains.

The spawn consists of a mass of suitable medium through which the threads of the mycelium or vegetative part of the mushrooms are thickly branched. It may be purchased in either bottle or brick form. The bottle spawn is the more popular type with commercial growers because it yields a quicker crop of mushrooms over a shorter period of time than the brick spawn. It is also sure to be free from contamination since it is enclosed in a sterile bottle, while the brick is exposed and thus there is a slight possibility of the entrance of other organisms.

Bottle spawn deteriorates quickly and is, therefore, in demand as a strictly fresh product, though it will keep for several months in cold storage. Brick spawn, on the other hand, will keep in good condition for a long period of time, it being known to produce mushrooms when over a year old if kept under favorable storage conditions. This long-life characteristic of brick spawn, together with the fact that it is convenient to handle, makes it popular for local retailers of seeds and spawn, since little care need be given it even though it may not be sold immediately. Good spawn is white and live looking; dead or unhealthy spawn is usually yellowish in appearance. Bricks should be broken to determine the health of the mycelium, and in case of bottle spawn, the mycelium may be seen through the glass.

In spawning a bed with bottle spawn the bottles are broken and the contents separated in forty to forty-five pieces the size of a walnut. If brick spawn is used, the bricks are broken into from 10 to 12 pieces. The cost of bottles of spawn in quantity is about five times that of bricks, but since the former cover nearly five times as much space, the cost of spawning a mushroom bed runs about the same no matter which type of spawn is used. In 1923-1924 the spawn from a well-known dealer was quoted as follows:

BOTTLE-SPAWN—$9.60 per box, containing one dozen quart bottles. Small quantities, $1.00 per bottle.

BRICK SPAWN—By Parcel Post, one brick, $.40; two bricks, $.75; three bricks, $1.05. By express, five bricks, $1.50; Seven bricks, $2.00; ten bricks, $2.50; twenty bricks, $4.40; twenty-five bricks, $5.50; fifty bricks, $9.00; one hundred bricks, $16.00, f. o. b. Coatesville, Pa.

Several strains of both bottle and brick spawn are offered by the spawn makers and include brown, white, and cream strains (all strains of *Agaricus campestris* or closely related species), different colors being in demand according to the preference of the market and of the grower. It is claimed by some mushroom producers that the brown and cream mushrooms ship better than the white strains.

## THE MUSHROOM DESCRIBED [1]

The mushrooms commonly grown in the United States are cultivated strains of the common field mushroom of our meadows, *Agaricus campestris* and allied species, fungi classified under the Basidiomycetes. This class receives its name from the basidia, erect cells on the under side of the cap which produce the reproductive bodies, called spores.

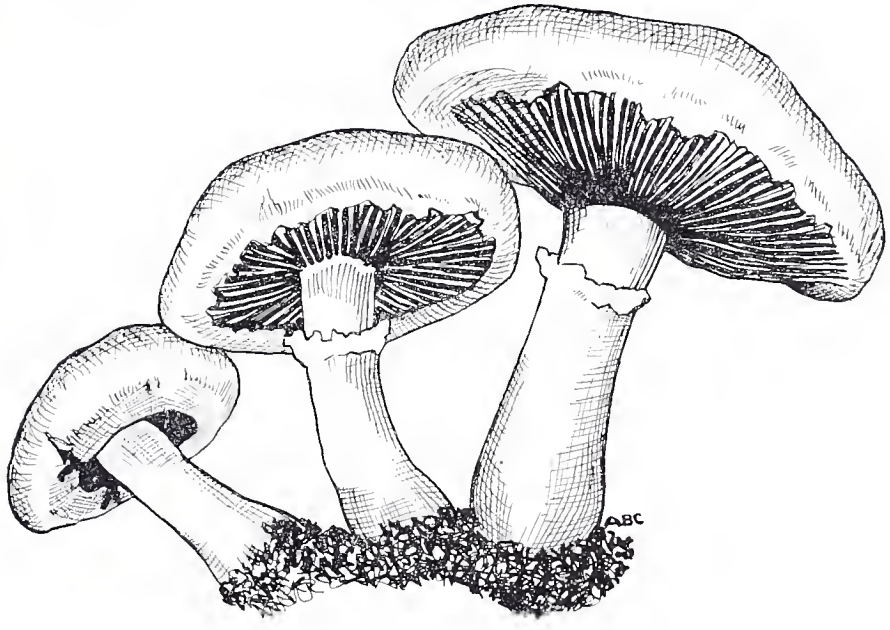

Fig. 1. Agaricus campestris, the cultivated mushroom.

The edible portion of the mushroom is the fruiting or reproductive part of the plant, which consists of a stem or stipe 2 to 5 inches in height, and an inch or less in diameter, a cap or pileus which meas-

(1) Acknowledgment is due Dr. L. C. Overholts, Department of Botany, Pennsylvania State College, for suggestions on botanical phases of the Bulletin.

ures about the same diameter as the height of the stem and about the same thickness as the stem diameter, and a ring of tissue called the annulus, around the stem just below the under surface of the cap. The annulus is formed from a partial veil of tissue which in the young stages of the plant reaches from the margin of the cap to the upper part of the stem and so forms a covering or protection for the gills. This veil is ruptured by the expansion of the mushroom in growth and remains on the stem as a more or less distinct ring, the annulus. Bits of this tissue may also remain attached to the margin of the cap. The under surface of the cap bears thin plates called gills which hang downward and radiate outward from the stem to the edge of the cap. On the swollen terminal cells (basidia) of these gills are borne the spores. The spores in mushrooms correspond in function to the seeds of higher plants though they are quite different in character.

After the veil has ruptured, and the cap has fully expanded, the spores will ripen and scatter like dust. If they fall upon a material suitable for growth, they will send out germinating tubes which take in moisture and food, and growth results. This growth of the mushroom is the vegetative stage and consists of thread-like branching masses of mycelium which spreads out through the material in which it is developing. The mycelium is commercially known as "spawn."

After a considerable growth of the mycelium during which time it has stored up nourishment, the fruiting bodies, or the mushrooms of commerce, will be developed. These are at first minute cushion-like areas of growth on the mycelium, which enlarge, become spherical in form, and are then called "pin-heads." These grow rapidly in size, to "buttons," and finally to the mature mushrooms. Mushroom growth might be compared to the growth of one of the higher plants as the tomato, the mycelium, or vegetative portion, representing the tomato plant, and the fruiting part or commercial "mushroom" the tomato fruit.

The color of the mushroom stem is white or cream, the upper surface of the cap may be white, cream or brown. The gills in white or cream mushrooms are pink until growth of cap ruptures the volva, then they soon turn brownish black. Brown capped mushrooms have grayish pink gills turning black.

The mushroom, having no green coloring matter, is unable to manufacture the primary food of plants and is therefore dependent on organic substances obtained from the roots of grasses, straw, and the like. The commercially grown mushroom obtains its carbohydrate food from the decaying straw or wood shavings used in bedding horses, or from the undigested plant remains in the manure. It

obtains its nitrogenous foods directly from the manure itself. These materials must be converted by bacterial and chemical action into digestible form. Such a process is accomplished through the composting of the manure as later described.

## THE FOOD VALUE OF MUSHROOMS

It should be remembered that the food value of mushrooms lies not alone in their actual energy value, but in the variety that their distinctive flavor lends to the menu.

The mushroom has sometimes been dubbed "vegetable beefsteak" and extravagant claims have been advanced regarding its food value. It should be stated first of all that the mushroom compares favorably with cabbage and some other vegetables in number of calories of food energy per given weight but ranks far below beef in this respect and only about one-third as high as potatoes. Pound for pound, cabbage will run of course considerably cheaper than mushrooms as will the other products just mentioned.

Table I shows the relative nutritive value of one pound of beef, of potatoes, and of cabbage, as compared with the mushroom, *Agaricus campestris:*

TABLE I

RELATIVE NUTRITIVE VALUE OF FOUR FOODS SHOWN IN FRESH WEIGHT PERCENTAGES.

| Food Product | Proteins | Fats | Carbohydrates | Calories |
|---|---|---|---|---|
| Beef (round) | .187 | .088 | | 720 |
| Potatoes | .018 | .001 | .015 | 325 |
| Cabbage | .018 | .003 | .049 | 140 |
| Mushroom | .018 | .003 | .046 | 132 |

## PRODUCING THE MUSHROOM

The main factors to be controlled in growing mushrooms are those of moisture and temperature. For that reason, any building, cave, or other place where the above conditions may be regulated so that they meet the requirements of the crop, should be satisfactory for mushroom growing.

Mushrooms in Pennsylvania are grown in caves, in especially built mushroom houses, under greenhouse benches, and in barns and warehouses that have been converted to the purpose.

The only cave of any commercial importance in the state is that used by the Rocky Cave Mushroom Company in Butler county. It contains over a million square feet of mushroom beds. The cave is operated by the Pittsburgh Limestone Company, only the abandoned rooms being used for mushroom growing. As it is naturally ventilated and holds a temperature of 53 degrees Fahr. throughout the year, it makes an excellent type of place for the growing of mushrooms.

In caves such as that used by the Rocky Cave Mushroom Company, the mushroom beds are made directly on the floor of the cave. Both

flat and ridged beds are used. The former type has manure placed to a depth of 8 to 12 inches, 3 feet wide and any length, with the sides as nearly perpendicular as possible.

The ridged or French beds that have been used by the Rocky Cave Company are about 2 feet wide at the base, 2 feet high, the sides sloping so that the flat top is only about 6 inches wide. The mushrooms on this type bed are produced over the sides as well as the top, while on the flat beds, they are produced only on the upper surface. The Rocky Cave Company prefers the ridged beds since they are said to keep their heat much longer, and they provide a slightly greater surface area on which the mushrooms are produced, than an equal floor space fitted with flat beds, therefore assuring greater production. However, the ridge bed takes more labor for construction and care than the flat bed, and because of the scarcity of labor skilled in making the ridged type, this firm will probably hereafter use only the flat beds.

Barns and warehouses used for mushroom growing are comparatively few in number though some old stone barns have yielded excellent crops.

The growing of mushrooms under greenhouse benches is naturally restricted to a few growers of vegetables or flowers whose houses are equipped with benches, placed at such a height as to make convenient the building of mushroom beds beneath them. The most common combination of crops is tomatoes on the benches and mushrooms underneath. Little trouble is found in making the beds. Eight-inch boards are laid on edge against the inside of the bench supports and the mushroom compost packed in to the proper depth; or 8″ x 1″ concrete sides may be made for the beds. After the crop is finished, the boards are removed, if such are used, and often the mushroom manure is then used as a mulch for the tomatoes. Some growers hang burlap from the sides of the benches to shut out most of the light from the mushrooms, though it is doubtful whether this practice is necessary. The quality of mushrooms grown under greenhouse benches is said by some growers to be poorer than those grown in caves or in mushroom houses. If this is true it is no doubt due to less favorable temperature and moisture conditions rather than to the effect of light. On the average, yields under greenhouse benches are not so high as in the case of crops grown in mushroom houses, though fine yields are not unknown.

Flat beds similar to those used by the Rocky Cave Mushroom Company are made on the ground beds in some of the Ashtabula, Ohio, greenhouses, between the rows of fall planted tomato plants and the mushrooms thus grown as an inter-crop with winter tomatoes. Good yields are said to be secured in this manner but to the writer's knowledge the practice has not been tried out in Pennsylvania.

## BUILDING THE MUSHROOM HOUSE.

Crop houses constructed especially for the growing of mushrooms are commonly used in the state, especially in Chester and adjoining counties. The walls of such houses are built of a great variety of materials, including wood, stone, brick, concrete, and hollow tile. The last mentioned seems to be the most satisfactory, since it provides good insulation to both heat and cold, is fire-proof, and durable. One objection advanced by some growers to hollow tile walls is that they sweat thus causing the moisture conditions within the houses to be variable. This same objection, however, is voiced against brick, stone, and concrete houses, in which the moist air comes in contact with cold walls and precipitation results. A sloping roof that provides a large air space and hence plenty of ventilation will help correct this difficulty.

For convenience in heating and to secure more uniform temperature during the warm months, many mushroom houses are built over excavations which may be several feet deep. When such a plan is followed, a well-drained location is essential. Houses with double wooden walls, the air space between the walls filled with some good insulating material as cork, sawdust, or shavings are popular. They are claimed to provide the most favorable conditions for mushroom growth, and are considerably cheaper than hollow tile houses to construct. However, they are not fireproof, and naturally are not so permanent as those built of the more durable materials.

One grower who built a new bank of wooden mushroom houses in Chester county in the summer of 1921, reports the cost of construc-

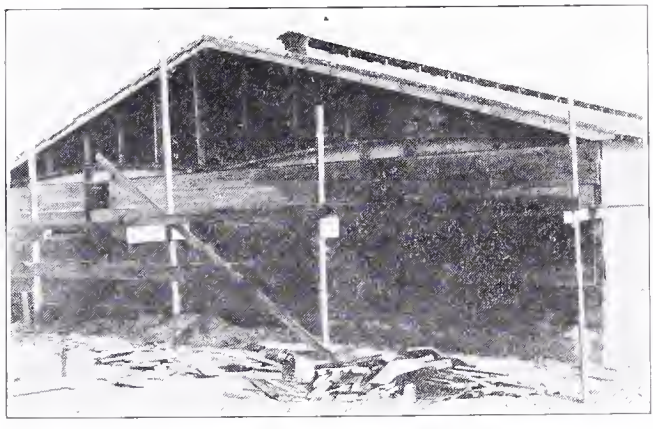

Fig. 2. Wooden mushroom houses are still popular. This one was built recently at Kennett Square, Pa. Note the ceiling arches.

tion of four single wooden houses each 18 feet by 60 feet, and containing about 5000 square feet of bed space, as $1800 to $2000 per house as compared with $3300 for the same size house in hollow tile. A Lancaster County grower estimates his cost of construction of double walled wooden houses at 50 cents per square foot of bed space.

There seems to be a concensus of opinion that the upper part of mushroom houses, whatever material the walls, should be of wood, the roof usually sloping at an angle of about 30 degrees or more, the attic thus made supplying a storage room for baskets, tools, etc. as well as providing an air space by which the mushroom crops are protected and indirectly ventilated. Concrete, tile, and slate roofs have not proved entirely satisfactory where tried. The roofs are commonly covered with tar roofing paper though with the more modern houses, asbestos shingles are used and are without doubt superior to the roofing paper.

Various durable woods are used for the construction of house walls and roof. Cypress and hemlock seem to have been popular in recent construction in Chester county. The interior framework is usually of these woods though sometimes less resistant woods are used in other parts of the house.

To economize space within the houses the mushroom beds are built one above the other in tiers of 3 to 9 beds, 4 to 6 being the common number, this depending chiefly on the height of the house. The upright supports are commonly 2″ x 4″ or 2″ x 6″ scantling set about 4 feet apart on a concrete base. The cross supports for the beds are usually 1″ boards though in some houses gas pipe supports are used. The whole supporting structure is sometimes made up of angle irons. The concrete base forms an eight-inch wall which serves as the sides for the lowest bed of the tier.

The bottom boards of the beds which are usually 1″ x 8″ to 12″ x 12′ to 16′, are laid loosely on short supporting boards that are nailed across the scantling. The side and end boards of the beds which are 1″ x 8″ to 10″ are laid on edge on the bottom board and rest against the inside of the upright supports, being held in place when the compost is packed in, thus doing away with nailing. Another advantage of this loose construction is that after the crops are harvested, the manure in the upper beds may be dumped below by simply turning the bottom boards on edge; and likewise the aeration, stacking, and fumigating of the wooden interior parts between crops is sometimes made easier. The lowest bed, with the concrete wall enclosing it, is made directly on the ground. Mushroom beds are from 3 to 8 feet wide, usually 3 feet for a wall bed and 6 to 8 feet if the bed may be approached from both sides. Six feet is the maximum width for convenience in caring for the beds, especially when picking the crop. The depth is commonly 8 inches, though it may be more, and the length depends on the length of the house.

The distance from the top of one bed to the bottom of the next bed above runs from 18 to 30 inches with 2 feet the most common distance. The average width of the alleys between the tiers of beds is 2 feet 2 inches and this seems to be the minimum for convenience.

Alleys of 2½ to 4 feet are usually provided at both ends of the houses. Mushroom houses run from 60 to 160 feet in length, 100 feet being the common size. Single houses are usually 18 to 20 feet wide, double houses 36 to 40 feet wide, though there are many houses of varying sizes. A single house will have a tier of beds on each side of a central walk, a double house two walks with a tier of beds on each side of each walk.

The ceilings of the houses are arched slightly, a single house having one arch, a double house two arches; the highest point of the arch comes just above the walk where the ventilators are placed. The warm air in the house naturally rises to the highest point, which is thus the section of the ceiling where the ventilators are located.

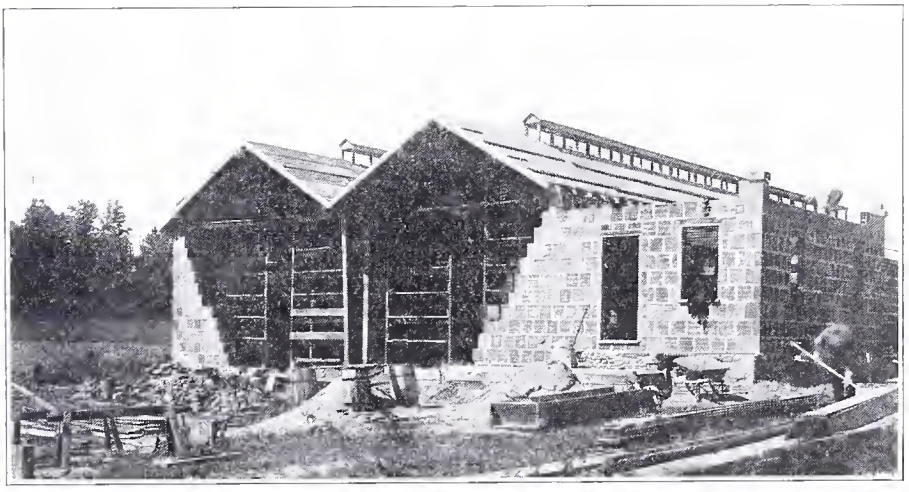

Fig. 3. Hollow tile mushroom houses and packing room under construction at Kelton, Pa.

The standard type of ventilation used in mushroom houses is a one-foot board in the ceiling above each walk. This is hinged and may be raised or lowered by a cord hanging down to the alley below. These hinged boards may or may not be continuous for the length of the house. They open into the air space or attic under the peaked roof, and this air space is continually open to the outside through a ventilator which extends along the ridge of the house. Some houses also have extra ventilating openings in the gable ends and occasionally additional circulation of air is provided through small apertures in the doors, that may be opened or closed as occasion demands. Cool air may also be admitted through air ducts near the floor.

## EQUIPMENT FOR THE MUSHROOM HOUSE.

The main equipment needed for mushroom houses is some carrier in which the compost may be hauled into the house for filling the beds and removed after the crop is finished. In a few cases an

overhead rail is placed near the ceiling and on this is run a litter carrier such as is often used in modern stock barns. This type of carrier has not appealed to many growers. The usual method of handling the compost now in use is a flat car run on a narrow track made of light T or angle irons and easily movable. When filling the lower beds the track is laid in the alley, for the upper beds it is placed at a higher level on 2″ by 4″ supports which are fitted in one way or another on the bed structure. The compost is forked into bushel baskets or galvanized pails and these are loaded on the flat car, which is then shoved in or out of the house, as the beds are filled or emptied. In small houses a wheelbarrow is sometimes used.

Wooden hand tampers are used in finishing off the surface of the beds, thermometers are needed to record temperatures of both beds and houses, hygrometers are desirable in order to keep check on the humidity in the houses, various types of weeders are used in lifting pieces of the compost for the insertion of spawn, manure forks for handling the manure, gasoline lights or electric lanterns are needed for cultural work, hose and greenhouse nozzles for watering, picking baskets for harvesting, knives and camels hair brushes are used in

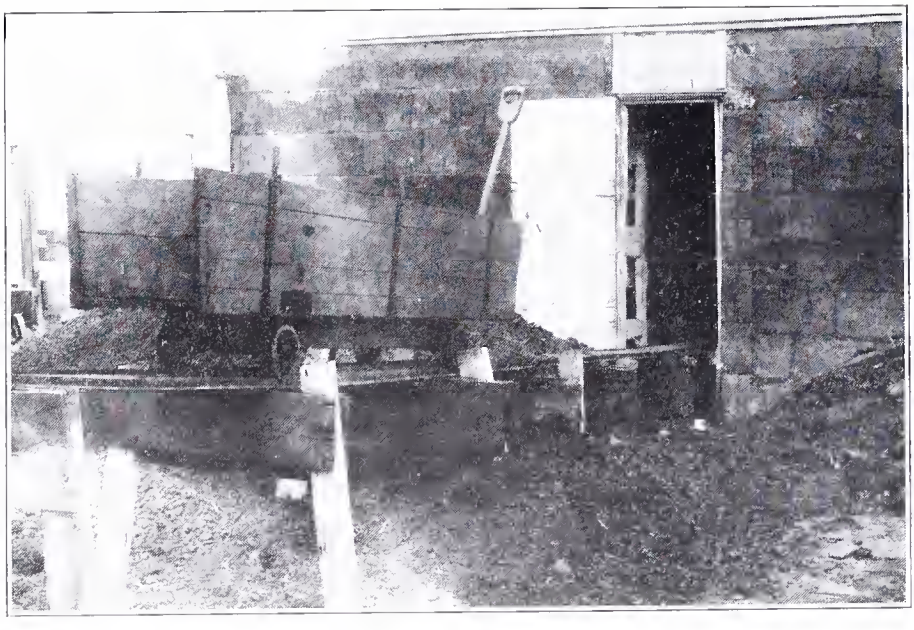

Fig. 4. Car and track for the hauling of compost into mushroom houses in Chester County.

preparing the mushrooms for market, galvanized pans may be used for burning sulphur, and hand sprayers of various sorts find use between crops for whitewashing the interior woodwork or spraying it with formaldehyde. The above list includes most of the small tools that are used for the growing of mushrooms.

Trucks are, of course, extensively used in hauling manure from the freight cars and for marketing. One of the larger firms in the state

uses a small tractor to haul wagons of manure, as they are filled, from freight cars on a siding at the plant, to the compost heaps, and to return the empty wagons from the compost heap to the siding for refilling.

## HEATING AND COOLING MUSHROOM HOUSES.

Practically all mushroom houses are equipped with hot-water heat, except in the case of growing the crop under greenhouse benches when the heating system may be steam since that is often used for the greenhouse crops. Two small greenhouses in the western part of Pennsylvania in which good crops of mushrooms are grown under benches, are heated by hot air flues.

The hot water coils are usually located on or near the ground. From these the warm air naturally rises and thus provides constant circulation and uniform temperature for all levels of the house. Since a temperature around 60 degrees Fahr. is maintained and the houses are well insulated, a comparatively small amount of radiating surface is needed. Hot water heat is preferred to steam heat for mushroom growing since it does not dry out the air as much as steam, hence it is easier to keep the beds properly moist; hot water is operated more cheaply since less fire is needed in mild weather and not so much attention to firing is needed at night.

Bituminous coal is in general use though a few growers use anthracite. This matter depends largely on location and local prices of coal. The amount of coal used will vary greatly according to the construction of the house and the season. According to reports, a ton of bituminous coal will supply heat for from 2,600 to 4,000 square feet of bed space for one season.

The temperature in even the best insulated houses rises too high in summer for the successful growing of mushrooms. In order to overcome this difficulty and make it possible to lengthen the season for mushrooms or even grow the crop the year around some growers are using cooling systems during the hot months, from May to September, by which currents of air are driven through cold water into the houses, thus lowering the temperature within. In extremely hot weather even a cooling system may not reduce the temperature enough to make summer mushrooms a certain crop. Since the temperature in caves remains almost uniform, summer and winter, no heating or cooling systems are needed in such structures.

## FRESH HORSE MANURE BEST FOR MUSHROOMS.

Practically the only type of manure used at present for mushroom growing is fresh horse manure from grain fed and straw bedded animals, that contains at least 1/3 straw and has been well permeated with the liquid part of the manure. Shavings manure is used to some

extent especially in the western part of the state, but is not satisfactory since it requires longer composting and spawn does not grow well in it. Smaller yields are thus secured. Hay manure is also unsatisfactory.

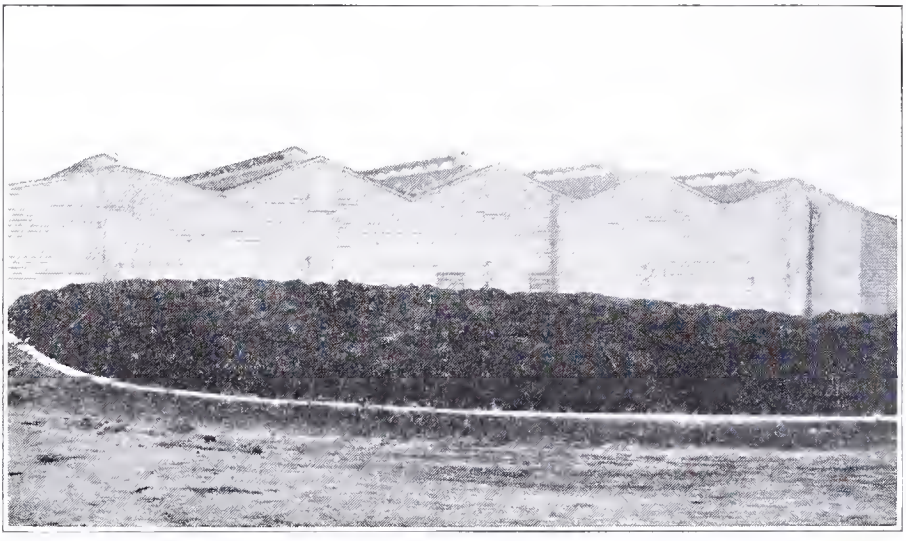

Fig. 5. Mushroom houses with wooden walls with manure composting pit in foreground

Most of the mushroom growers secure the manure in carload lots from New York, Philadelphia, and Pittsburgh. The price during the 1923-1924 season ran $5.80 per ton from New York, of which cost a large percentage was for freight. The New York manure is preferable to that secured from Pittsburgh since the latter usually contains a large amount of shavings and too little straw. However, the freight on manure from the eastern cities makes the price seem prohibitive to growers in western Pennsylvania so they have been relying on Pittsburgh for their mushroom manure. It is a question whether it would not be desirable for these growers to get the costlier though better manure from New York, since so much better yields may be had. A few growers who have a comparatively small amount of bed space are able to get their manure from liveries or other local sources at a much lower rate than charged for that shipped by the carload.

## COMPOSTING MANURE FOR MUSHROOMS.

The manure is usually not fit for use when first secured, but must be treated for two weeks or more before it is packed into the mushroom beds in order that fermentation may so act upon the manure that it may change the food materials in it to forms that the mushrooms can use and may thus favor the growth of the mushroom mycelium rather than the development of various other fungi which would be favored by conditions of the fresh manure. The manure

is placed in flat top piles 3 to 4 feet high, at least that wide, and any length desired. If dry, it is wet down thoroughly. After three or four days the whole pile is turned over, placing the manure that was on the outside of the pile in the interior of the new pile, at the same time shaking it with the manure fork, sprinkling with water as it is piled, and compacting it slightly by tramping, all these precautions tending to insure uniform fermentation throughout the pile and to prevent burning or "fire-fanging" which is considered by some growers to lower the productiveness of the mushroom beds made with such manure. The turning is repeated three to five times at intervals of a few days. During this time the temperature of the manure may reach 140 to 150 degrees Fahr. The majority of growers though not all of them mix some soil with the manure since the compost is then ready to place in the beds earlier than if manure is used alone. Three or four inches of good loam may be spread over the fermenting manure after each turning, this soil getting thoroughly mixed through the manure at the subsequent turning. Others practice adding 8 or 10 inches of soil just before the last turning and some growers prefer to mix soil with the manure just as it is forked over to take into the houses.

When the compost has become a coffee-brown color, the straw in it has broken up and lost its new appearance, the mass has a "greasy" or velvety feel, and its odor has become that of new-mown hay, it

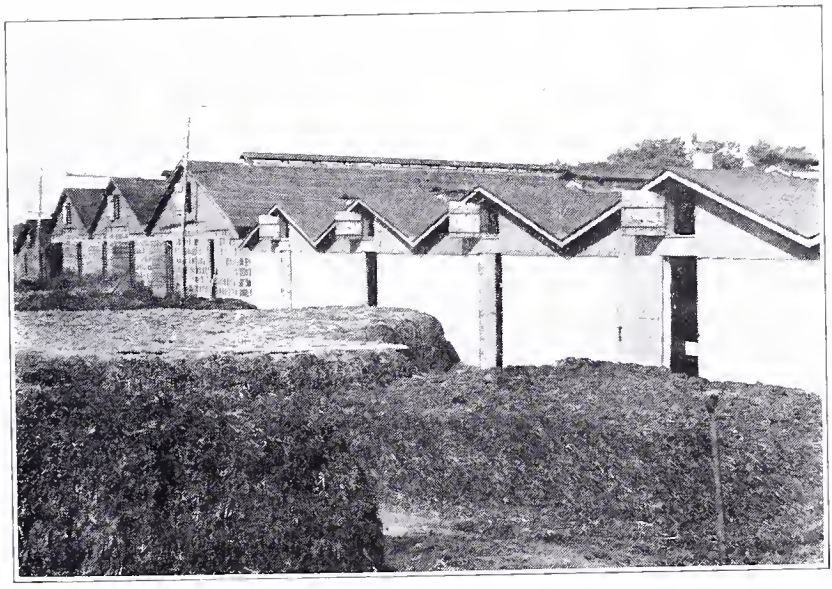

Fig. 6. Manure compost piles at a Kennett Square mushroom plant. Note loam covering on pile near center of picture.

should be ready for the beds. At this time the compost should contain sufficient moisture so that when some of it is pressed in the palm of the hand, the hand becomes wet, but not enough water should be present that it may be squeezed out of the mass in a stream. If there is not enough moisture present, the composted manure should be sprinkled as it is forked over to take into the house.

There is probably more danger of having the manure too dry than too wet. The period of composting generally lasts from two to six weeks depending on the condition of the manure on arrival, the treatment it receives, and weather conditions. The essentials of good composting are sufficient moisture at all times and enough forking over to cause uniform fermentation throughout the pile.

As mentioned above the manure after composting has an odor of new-mown hay. However the unpleasant odor of the manure when fresh and during the fermenting process, as well as its use as a breeding place for flies, has resulted in some towns forbidding the erection of further mushroom plants within the borough limits. Such is the case in Kennett Square.

## FILLING MUSHROOM BEDS WITH COMPOST.

The compost is usually forked into baskets, galvanized cans, or other similar containers and hauled into the houses on flat cars or wheelbarrows. It is dumped into the beds and packed firmly to a depth of 8 to 10 inches.

Occasionally growers secure old rather than fresh manure for mushroom growing. This type is not considered so desirable but if it has not fire fanged, it may be used, often without composting. Some growers ascribe no value to the heat in fresh manure but would as soon use cold manure, if its physical and chemical conditions are satisfactory.

The amount of manure needed to fill mushroom beds will depend on the manure itself and the depth of the beds. A car of average manure containing from 20 to 40 tons, should fill a bed 1400 to 2800 square feet in size to a depth of 8 inches. A ton should work up to cover 70 square feet to the same depth.

After the beds are made the temperature of the compost may rise over 100 degrees Fahr. Spawning cannot be done with safety until the temperature recedes to 70 to 75 degrees Fahr. and indications are that it will continue to drop. This will usually be a matter of 10 days to two weeks or possibly longer. The temperature is determined by thermometers thrust into the beds so that the bulbs are 3 inches or more below the surface.

If brick spawn is used, the bricks are broken into 10 or 12 pieces; if bottle spawn, the bottle is broken and the contents separated into 40 or 45 pieces about the size of a walnut, or as most of the growers say "pinches of spawn". A piece of the brick or the bottle spawn, as the case may be, is then inserted about one inch deep every 10 to 12 inches all over the bed, and the compost firmed well over it.

A period of two weeks to a month will elapse before the spawn has run well through the manure. The latter stages of this process may be looked for by lifting the side boards of the bed, and if the white threads of the mycelium are seen covering the surface of the exposed

side of the bed, it is then ready for a "casing" or covering of ½ to 1 inch of loam. Some growers "case" sooner than this, when the mycelium has "run" only three or four inches from the original pieces of spawn. The casing seems to serve several purposes; it makes a firm material to support the growing mushrooms, helps to retain the moisture in the manure below, and seems to induce the mycelium to produce its fruiting bodies, the mushrooms.

Occasional growers will spread a mulch of straw over the beds in order to keep the beds from drying out on the surface previous to "casing". Such a mulch is removed when the casing is applied.

Six to eight weeks usually elapse after casing before enough mushrooms appear for picking to start. Slow growth may be due to several causes; poor spawn, poorly fermented manure, large amount of shavings in the manure, low temperature, or unsatisfactory moisture conditions.

## CARE NEEDED IN WATERING.

Little heavy watering is needed for mushrooms if the manure has been properly prepared before placing it in the beds. All growers agree that if possible no watering should be done from the time the beds are spawned until the casing is applied. This is not always possible, especially for the first crop in the fall when the warm weather will tend to dry out the manure. Neither is it possible in all cases where mushrooms are grown under greenhouse benches at higher than ideal temperature. If watering is necessary, light sprinklings should be given rather than heavy drenches of water.

After the casing is applied, watering consists in sprinkling this surface with a hose, usually with a greenhouse nozzle attached, just often enough to keep the beds merely moist. As long as the casing is kept moist the manure below will seldom dry out. Heavy watering is not desirable, in only rare cases is so much water applied to the surface that it penetrates into the manure. More water will be needed after the mushrooms appear than before.

Sprinkling is best done just after picking as all mushrooms exposed to the water turn brown and rot; any "buttons" that have been so exposed are picked off after watering and destroyed. Tepid is better than cold water for sprinkling the beds, a temperature of 80 degrees being considered desirable by some growers. The walks and walls of the houses and even the framework of the beds are wet down frequently in order to raise the humidity of the houses, 65 to 75% moisture in the air being considered satisfactory by most growers.

## CAREFUL VENTILATION ESSENTIAL.

Ventilation and watering go hand in hand. The growing mushroom takes in oxygen and throws off carbon dioxide gas. For this reason and because of the high humidity maintained in the houses, the air

must be constantly renewed in order to permit normal mushroom growth as well as to prevent the formation of molds on the surface of the beds and various mushroom diseases. At the same time drafts of cold air blowing over the beds would check the growth of the mushrooms as well as dry out the beds. Therefore careful ventilation is essential. Cold air is usually admitted near the floor through cold air ducts, is warmed by the hot water pipes in or near the walks, rises and escapes through the ventilators in the roof.

## PROPER TEMPERATURES IMPORTANT.

The most desirable air temperature for the growing of mushrooms ranges from 50 to 65 degrees Fahr. The cave of one large mushroom grower keeps a uniform temperature of 53 degrees Fahr. while most of the mushroom houses are held at or near 60 degrees. Some growers claim that growth of mushrooms will stop and even the spawn may be killed at temperatures of over 70 degrees Fahr. if same is long continued while others are able to produce successful crops under greenhouse benches when the temperature sometimes reaches 75 degrees Fahr. if plenty of ventilation and moisture are provided.

The bed temperature after the first high heat of the manure has subsided, will keep much the same as the house, or slightly higher, if proper conditions are maintained. Should the beds get too cold, production may cease for a time but the spawn will probably live and fruit again when the temperature rises. Too great heat in the beds or the houses, however, such as previously mentioned may cause the death of the spawn through fogging off or the attacks of bacteria, fungi, or insects that have been stimulated to activity by the heat, rather than through the spawn being killed directly by the high temperature. Lower temperatures, of about 50 to 55 degrees, produce mushrooms more slowly but of finer quality and more solid than do higher temperatures.

## MUSHROOMS REQUIRE LITTLE LIGHT.

No light is given to mushrooms grown in caves or mushroom houses except as may be admitted indirectly through the opening of doors, windows or shutters when picking the crop or given by lamps when carrying on various cultural operations. Mushrooms grown under greenhouse benches may receive considerable indirect light though some growers in such cases shut out as much of the light as possible by tacking curtains of burlap to the sides of the benches. Light itself has no injurious effect on the mushrooms, as may be realized from the fact that they grow in direct light in the field; however since sunlight is accompanied by heat, the temperature may be appreciably raised thereby, hence favorable and uniform temperatures may be more easily maintained if light is excluded.

## GROWERS EXTEND PRODUCING SEASON.

The main season of production for mushrooms runs from the middle of October to the first of May, the first beds being spawned in late August or early September. At other times hot weather prevents their growth in the average mushroom house. With cooling systems installed in their houses, some growers are able to extend the length of the season, producing mushrooms from mid-August to the middle of June, or even throughout the year. In caves, where the temperature remains uniform during 12 months of the year, crops are grown winter and summer.

Fig. 7. An interior view of mushroom house showing construction features and beds in bearing.

Most of the growers fill and spawn their beds in succession so as to provide a steady crop throughout the picking season. Others who practice mushroom growing as a side line to other farming hasten to

spawn all the beds as early as possible in the season so that the crop may be off before the rush of farm work in the spring.

The first mushrooms to form will appear directly over the places where the pieces of spawn have been inserted. These groups are known as flushes. Gradually the fruiting area should spread over the whole bed. The average length of picking season runs from two to three months, so that beds spawned in early September may mature their entire first crop early enough that the beds may be refilled and spawned in time to get a second crop before hot weather. Sometimes the crop from the first spawning may be borne over a period of four or five months and thus make the growing of a second crop impossible or impractical except in caves or in houses equipped with cooling systems. Such was the case in the season of 1920-1921 with the mushroom crop grown in an old stone barn by one large grower. The beds in the barn were spawned early in the fall with the expectation of getting the first crop off in time to grow a second before May 1. The beds started to bear the last of November and continued to bear until late April, yielding in the one crop 1½ pounds to the square foot.

Fig. 8. Section of mushroom bed under greenhouse bench, New Castle, Pa. Note flushes of mushrooms that have appeared over the spots where the spawn was placed.

## PICKING AND PACKING THE MUSHROOMS.

In the height of the season mushrooms develop so quickly that pickings may be made as often as twice a day in order to secure them in prime condition. The mushrooms are twisted off rather than cut,

since the latter practice would leave stubs that would form favorable places for rots to develop. Where removal of several mushrooms from a cluster leaves a depression in the bed, such depression is filled with soil such as is used for "casing".

The mushrooms are usually placed in large baskets or trays, taken to the packing room, the bases of the stems cut off, the caps sometimes brushed with a camels hair brush to remove dirt, graded and packed.

One firm gets rid of much dirt in the packing room by having the pickers trim the stems as the crop is harvested. Such trimming removes the base of the stem with the dirt clinging to it.

Mushrooms are generally separated into three grades of each color grown. First grade includes those mushrooms which are large in size, though not fully expanded, and free from blemishes of any sort. The second grade contains a smaller size mushroom similar in maturity and condition to the first grade. Grade three may include the "button" size, or may contain some mushrooms that have completely opened, and some that have small spots or blemishes that do not make the product unmarketable. Some growers make a separate grade of the button size for special trade or may include them in grade two. All badly spotted or otherwise damaged mushrooms are discarded. A few growers pack all sizes as one grade but at least three grades seem desirable for best appearance and highest returns. When graded, the grade and color are stamped on the package.

The principal package used is the four-quart Climax basket, which holds three pounds of mushrooms. When shipped, these are packed in bundles of six, three tiers of two baskets each, the bundle bound with three wires. The baskets are usually lined with a thin grade of paper, or if unlined, a sheet of paper is laid over the top of the contents before the veneer cover is put on. The wire handle has a bend in it just above the top of the basket, so that when the veneer cover is snapped into place its edges fit into and are held firmly in the curves of the handle. For summer shipment, at least one large mushroom company in the state uses cork-lined boxes which hold 18 four-quart Climax baskets. The insulated container thus provided makes more certain the arrival of the mushrooms on the market in good condition. A slat lid rather than a solid one is also often used in summer to insure better ventilation.

Pasteboard boxes of various kinds, usually ventilated through holes in the top and sides, and holding one pound of mushrooms, are used for shipping to some markets, especially to cities in the middle west. Chip market baskets holding five, six, and ten pounds, and a two-pound pasteboard box are also used in some cases for marketing locally within the state. The larger packages are not desirable since heat generated in them will be considerable and the consequent "sweating" results in loss of flavor and injury to the product

through the development of molds and bacteria. One Western Pennsylvania grower uses a glazed pasteboard box with a lace paper liner holding one pound of mushrooms. These extra quality boxes are comparatively expensive but because of the fine appearance of the package and the fact that a special trade is catered to, the grower in question receives a higher return for his mushrooms than other growers in the same vicinity, who use the more common package.

## PENNSYLVANIA MUSHROOMS HAVE WIDE MARKET

Mushrooms from Pennsylvania are shipped to all larger cities in the Northern States as far west as Minnesota. New York is the main market depended on, the hotels and restaurants there absorbing a large supply. Philadelphia, Boston, Wilmington (Del.), Pittsburgh, Cleveland, Chicago, Toronto (Canada), and St. Paul (Minn.) are important large markets reached by Pennsylvania mushrooms. Dozens of smaller cities in the North are supplied regularly through their local Commission men by Pennsylvania growers who have catered to their trade.

Since mushrooms continue growth after they are picked and therefore soon spoil, prompt marketing is essential. If carefully packed and shipped immediately after picking, there is little danger from shipment in the winter months during 24 to 48 hours. Mushrooms in aerated packages will keep about two days at ordinary temperatures and some time longer under refrigeration. Because of their perishability, mushrooms have not been extensively shipped to the Southern States in the past, the higher temperatures prevailing there often causing spoilage before the product reached the consumer. However, the amount going to the South is increasing, one extensive grower in 1924 sending his whole crop there. Summer shipments are usually made only to nearby markets as New York, Philadelphia, and Pittsburgh, the more distant markets as Chicago being little considered by Pennsylvania growers at that season.

The major part of the mushroom crop is handled efficiently by commission men and wholesalers, though the retail trade receives some shipments direct from the growers. A small part of the crop is handled on the curb markets in such cities as Pittsburgh and Wilmington. City hotels and restaurants, especially in New York and Philadelphia, are supplied direct from the grower. Distribution of a perishable crop like mushrooms direct to the consumer is most desirable, where possible.

Fig. 9. Mushrooms packed for market. Baskets left to right show:
1. Thin paper protector used over mushrooms before placing lid.
2. Brown mushrooms, first grade. 3. White mushrooms, first grade.
4. Slat lid used for summer shipments.

Railroad and trolley express, parcel post, and trucks satisfactorily transport the mushroom crop to market destinations. A large part of the Southeastern Pennsylvania mushrooms is shipped directly to New York City by truck. Express and parcel post are also greatly depended on for prompt delivery. The use by the larger growers of pre-cancelled stamps for parcel post shipments greatly facilitates marketing, from the standpoint of both grower and the post office clerk.

## PROFITABLE MUSHROOM YIELDS

Profitable yields for one crop run from one-half pound to two pounds per square foot of bed space, one pound being considered a good yield, many growers seldom obtaining such a high average. Usually the yields from beds made under greenhouse benches and in caves run lower than well cared-for beds in mushroom houses, but this is not true in all cases. On 1350 square feet of bed space under greenhouse benches, one grower of New Castle on May 1, 1921 had a yield of 2150 pounds for the season, with three beds still yielding at that time, one of these having been refilled and spawned for the second crop. In an old stone barn, the Keystone Mushroom Company during the season of 1920-21 produced a single crop that yielded steadily from November to April and averaged 1½ pounds per square foot.

## INSECTS AND DISEASES AND THEIR CONTROL

The most troublesome insects reported by Pennsylvania mushroom growers include gnats, springtails, mites, and sowbugs. The damage done by gnats is the feeding of the larvae upon the mushrooms, rendering them unmarketable. These pests are especially destructive in warm weather, and are pretty well kept under control by holding the temperature of houses to 55 degrees, screening openings to prevent the entrance of the "flies", the proper composting of the manure,

and, in case of severe infestation, fumigation with tobacco is recommended by the United States Department of Agriculture. Gnats are not usually serious pests to the winter crop.

Mites are very destructive to the mushroom in all stages of its growth as well as to the spawn and when once established in a bed, are almost impossible to control. The chief measures to be taken are, therefore, preventative. Thorough cleaning of the houses between crops and screening to prevent the entrance of small flies on which the mites may be carried, will help to control these pests. When once introduced into the beds, the compost should be removed and be destroyed or sterilized, and all parts of the house thoroughly disinfected with a carbolic acid wash. Like the gnats, mites are less active at lower temperatures.

Springtails feed directly on the gills and caps of the mushrooms. Preventive measures as for other insects are most effective. When once established in a house, fumigation with hydrocyanic acid gas, and dusting the beds with pyrethrum or with quicklime are recommended. A spray of 2% lysol is effective but will somewhat damage the growing mushrooms.

Sowbugs, also known as "woodlice", are grayish, oval creatures with seven pairs of legs, and are frequently introduced into mushroom houses in the compost. They feed on the mushrooms as soon as the first buttons appear. Fumigation of houses with hydrocyanic acid gas will prove effective, as should poison bait placed about the beds in the sections infested by the sowbugs. The best bait to use is raw potato or raw apple dipped in Paris green or arsenate of lead.

## COMMON DISEASES CAN BE PREVENTED.

No diseases have been reported recently as serious in Pennsylvania. The securing of good spawn, proper temperature, ventilation, and watering in the houses, and fumigation between crops will tend to prevent the entrance of diseases into the mushroom beds. The disease most likely to occur is known as the Mycogone Disease. Its characteristic injury is either a deforming of the mushrooms, with enlargements of cap, stipe, and gills, and sometimes a mold-like coating of these parts; or the mushrooms may have greatly enlarged stems and caps poorly or not at all developed, soft texture, and they may often decay while still quite small. The spawn is also attacked by this parasite and since the spores may remain alive even under unfavorable conditions for a year or more, the disease is difficult to eliminate. It may be spread through the house by implements, currents of air, or by the laborers when harvesting the crop. Spraying the diseased beds with 2½ % lysol solution is recommended and fumigation with formaldehyde after the beds have ceased bearing, such as is later described, will prevent the disease being carried over from one season to the next.

## FUMIGATION AS A CONTROL MEASURE.

Thorough cleaning of mushroom houses between crops is the most effective means used by Pennsylvania growers to prevent the multiplication and carrying over of both insects and diseases. The boards of the beds are removed, the compost hauled out, the houses tightly closed, strips of paper often being pasted over the cracks around the doors and windows, and the house fumigated with either burning sulphur or formaldehyde. The sulphur may be burned in shallow galvanized pans or may be placed in heaps directly in the alleys and earth banked around the sides to prevent danger of firing the interior woodwork. Two ounces of powdered sulphur is needed for each 1000 cubic feet of space. When fumigating with formalin, three pints of this material (40%) and 1½ pounds of potassium permanganate are needed for each 1000 cubic feet of space. Large earthenware containers are placed along the walks of the houses, one container for every 25 or 30 feet of length of the house. The total amount of materials is divided according to the number of containers used, the formaldehyde poured into each container and paper bags of the permanganate placed alongside. The operator should begin at the end of the house farthest from the exit door, drop the bags successively into the formalin and leave the building quickly before the fumes hurt the eyes. In case of both formalin and sulphur fumigations, the house is kept closed for 24 hours or more, then opened to air and to dry out. No lighted lamp should be taken near the mushroom house during formalin fumigation for the formaldehyde gas in a confined state is explosive.

In place of fumigation or even in addition to it, the interior woodwork is frequently treated with a formalin solution or a carbolic acid wash, whitewashed, or sprayed with a strong copper sulphate solution. One Pennsylvania firm sterilizes its houses by forcing in a steam of carbolic acid solution. Another firm cannot fumigate its caves but manages to control pests by whitewash and lysol solution. Fumigation, however, is a very practical method for the modern mushroom house. One grower in Chester county has his houses so built that the gable ends may be swung open as double doors and the interior framework torn down so that the interior may be thoroughly aired in summer.

## THE DISPOSAL OF USED MUSHROOM MANURE.

The old compost and soil used in growing mushrooms should never be employed in the growing of subsequent mushroom crops since there would be much danger from multiplication of insects and diseases, nor should it be used on land from which the grower expects later to take soil for use in making mushroom compost. However, the used material is of considerable value in other agricultural operations. As a top dressing for garden and field crops, this com-

post has a fertilizing value as well as a value in improving the texture of the soil. It is largely used by greenhouse men in the mushroom districts as mulches for tomatoes and other such greenhouse crops. Because of its finely rotted condition, mushroom manure is of particular value as a top dressing for golf courses and as such is sold in considerable quantity by mushroom growers.

## CARE AND ATTENTION REQUIRED FOR SUCCESS

As the public taste for fresh mushrooms increases, so must the mushroom "banks" or the caves be increased to meet this demand. Mushrooms are rising in popularity as a food. The number of new houses and the lack of gluts on the market are indications of the increased demand. Although the food value of mushrooms is not high, their flavor adds variety to the menu and recommends their more frequent use by the masses of people. Many of our smaller cities and towns, at present greatly undersupplied or not supplied at all with mushrooms, offer excellent markets for this article of food.

Many have focused their eyes on mushrooms as a get-rich-quick crop. While fair profits should be realized by careful growers, enormous returns are not to be expected. The manager of one of the largest mushroom plants in the state estimated that for the season of 1920-1921 the average cost to his firm of placing on the market a three-pound basket of mushrooms was $1.15. During that period the price received per basket ranged from $.85 to $1.50.

Anyone who considers entering the mushroom business should first make a study of the costs of production which include such items as: depreciation; interest; insurance; taxes; compost; soil; spawn; labor; coal; water; electricity; spray materials and fumigants; telephone and telegraph; baskets or boxes; twine, tags, paper, wire, etc.; and delivery of product.

The assurance that good spawn may now be secured gives the grower a greater chance of success than formerly. However, to be successful, just as constant and wise attention must be exercised in growing mushrooms as in any of the other more intensive agricultural enterprises such as rose growing, greenhouse tomato growing, or poultry raising. Only men who have had some experience in growing mushrooms, who are interested in the work, and who will continually study new phases of their culture and market conditions, should go into the mushroom business. Lack of information and poor spawn have caused many of the failures in the past, but to balance these failures there have been many conspicuous successes.